

# GNSS calibration of VTT receivers with respect to PTB G1 (1019-2023)

## Summary

From August to October 2023, Physikalisch-Technische Bundesanstalt (PTB) conducted a trip to calibrate GNSS equipment owned by VTT Technical Research Centre of Finland Ltd, Centre for Metrology (VTT). The trip started and finished at PTB, providing closure with respect to the PTB Group1 reference receivers.

The operations and report of measurements are described in the [report by PTB](#).

- **Final results for the calibrated systems**

The INTDLY values of the receivers given in Table 1 have been computed by PTB based on the results of the Group 1 trip [1001-2020](#) for PT13 (GPS and Galileo) and should not be updated to reflect later changes in the conventional INTDLY values of the reference receiver.

For a P3/E3/PPP UTC link A-B involving any Group 1 and any receiver in this trip, the uncertainty resulting from the calibration,  $U_B(A-B)$ , is computed as

$$U_B(A-B) = (U_{CAL0}^2 + \Delta U_{CAL}(A)^2 + \Delta U_{CAL}(B)^2)^{1/2} \quad (1)$$

where  $U_{CAL0} = 2.5$  ns is the conventional Group 2 value, and where  $\Delta U_{CAL}$  (generally zero) is specified for each system.

Changes in the set-up of the receivers after the calibration must be accounted for as described in section A.3.6 of the most recent [BIPM calibration guidelines](#).

Table 1. Final P1/P2/E1/E5a INTDLY values from the 1019-2023 exercise. Values of REF DLY and CAB DLY during the calibration are also indicated for reference. All values are in ns date in YYYY/MM/DD format. “Meas. Date” refers to the first day of the differential calibration, to which the calibration results can be applied. “Impl. Date” is the MJD when the results should be implemented in the receiver.

| System | BIPM | Meas. date | INTDLY P1 | INTDLY P2 | INTDLY E1 | INTDLY E5a | REF DLY | CAB DLY | Note | $\Delta U_{CAL}$ | Impl. date |
|--------|------|------------|-----------|-----------|-----------|------------|---------|---------|------|------------------|------------|
| MI04   | MI04 | 2023/08/23 | -39.2     | -38.7     |           |            | 8.6     | 215.4   |      | 0.0              | 60275      |
| MI05   | MI05 | 2023/08/23 | 19.1      | 18.4      | 21.6      | 20.9       | 5.1     | 96.2    |      | 0.0              | 60275      |
|        |      |            |           |           |           |            |         |         |      |                  |            |

Notes:

Version history

V1.0 2023/11/03: Publication of results from V1.2 of the PTB report.